1 Answer the following questions and write your answers in the boxes provided.

1) Let \( x = \frac{3 + \sqrt{3}}{3 - \sqrt{3}} \) and \( y = \frac{3 - \sqrt{3}}{3 + \sqrt{3}} \). Calculate \( x^2 - y^2 \).

2) Solve the equation \( x^3 - x^2 - 10x - 8 = 0 \).

3) Solve the equation \( 2 \sin^2 x - \cos x = 1 \) (0 \(\leq x < 2\pi\)).

4) Solve the equation \( 2^{2x+2} + 3 \cdot 2^x - 1 = 0 \).
5) Solve the inequality \((\log_3 x)^2 < \log_9 x^4)\.

6) Solve the inequality \(\sin 2x > \sqrt{2} \sin x\) \((0 \leq x < 2\pi)\).

7) Let \(\vec{a} = (1, 2, 3), \vec{b} = (3, 2, 1), \vec{c} = (5, 4, 3)\). Find the value of \(t\) such that \(\vec{a} + t\vec{b}\) is parallel to \(\vec{c}\).

\[ t = \]

8) Let \(O(0, 0)\) and \(A(3, 1)\). Let \(A'\) be the symmetric point of \(A\) with respect to the line \(y = 2x\). Calculate the area of the triangle \(OAA'\).

\[ \text{Area} = \]
9) The sequence \( \{a_n\} \) satisfies the following conditions. Calculate \( \sum_{n=1}^{5} (a_n - 5) \).

\[ a_1 = 3, \quad a_{n+1} = 2a_n \quad (n = 1, 2, 3, \ldots) \]

10) Calculate \( \lim_{x \to 0} (\sqrt{x^2 + 4x + 5} - \sqrt{x^2 + x}) \).

11) Let \( f(x) = \frac{\cos x}{\sqrt{e^x}} \). Calculate \( f'(0) \).

\[ f'(0) = \]

12) Calculate \( \int_{1}^{2} (3x^2 - 4x) \log_e x \, dx \).
2 Let \( I = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} \) and \( O = \begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix} \). Answer the following questions and write your answers in the boxes provided.

1) Let \( A = \begin{pmatrix} 1 & 3 \\ 3 & 5 \end{pmatrix} \) and \( B = \begin{pmatrix} x & 3 \\ 3 & 6 \end{pmatrix} \). Find the value of \( x \) which satisfies \( AB = BA \).

\[ x = \]

2) Let \( A = \begin{pmatrix} 1 & 2 \\ 2 & 4 \end{pmatrix} \) and \( B = \begin{pmatrix} -2 & x \\ 4 & y \end{pmatrix} \). Find the values of \( x \) and \( y \) which satisfy \( BA = O \).

\[ x = \quad y = \]

3) Let \( A \) satisfying \( A^2 = A - I \). Find \( A^{15} \).

\[ A^{15} = \begin{pmatrix} \end{pmatrix} \]
3 Answer the following questions and write your answers in the boxes provided.

1) Calculate \( \int_{0}^{\frac{\pi}{4}} \cos^2 x \, dx \).

2) Calculate \( \int_{0}^{\frac{\pi}{4}} \cos^3 x \, dx \).

3) Calculate \( \int_{-\frac{\pi}{4}}^{\frac{\pi}{4}} (\sin x + 2 \cos x)^3 \, dx \).